All contributions to be sent to the Editor, 57 Church Street, Old Isleworth, Middlesex. (Telephone, Hounslow 0391.)

British Journal of Anæsthesia

Vol. XXII, No. 2 April 1950

EDITORIAL

A BATTLE is being waged at the moment to assure the status of anæsthetic technicians. Under present conditions these people have no recognized qualifications, nor have they to undergo any specific training. Their knowledge and practice is only achieved in the hard school of experience and by courtesy of the Theatre Sisters, under whose jurisdiction they work. They have been recruited for the most part from the ranks of theatre porters. Intelligence, willingness and the all-important practical "know-how" have determined their selection. Time has more than justified their employment and sad indeed would be the condition of the anæsthetic service in many of our larger hospitals were they to disappear. We look to them to ensure that the soda lime is changed. They sterilize our syringes, our tubes, and lay out our trolleys for regional anæsthesia. They care for and maintain in working order our machines and even on occasion, by squeezing the bag, maintain adequate respiration while the anæsthetist is otherwise occupied. Their skill with their hands is often invaluable for the construction of small pieces of apparatus and for running repairs. By ensuring that everything is to hand and ready for use when it is needed they assist in the transfusion service and in practically every activity of the operating theatre.

Despite all this it appears that lack of recognition is resulting in depletion of their ranks. They can only join the "dustman's union", and therefore have no access to Whitley machinery. This means that their range of remuneration is fixed within the limits for any other manual worker in the hospital and bears little relation to their usefulness, their skill, or the responsibility which in practice they are called upon to bear. As a consequence they do not remain anæsthetic orderlies but pass on to more lucrative fields. Thus they seldom fulfil the detailed requirements which are likely to be laid down for any future qualification which might be instituted. A vicious circle is established and it looks as though their status will never be raised. The only alternative is for anæsthetic nurses to take their place and we do not believe that mechanical work of this nature is the best use for our impoverished nursing man- or woman-power.

It is to be hoped that all anæsthetists in all areas will press hard for their suitable remuneration and upgrading. Their case should be brought before Regional Committees, the various anæsthetic bodies that are likely to be interested and, perhaps most important, the British Medical Association.

. . . . .

THE Association of Anæsthetists of Great Britain and Ireland has funds available for research work and invites applications from candidates who possess the D.A. or a university science degree. The appointment would be for one year in the first instance with the possibility of it being continued for a second. The applicant would be expected to make his own arrangements for any necessary laboratory facilities to carry it out, although these must have the approval of the Association. The salary offered is

GILBERT BROWN

RALPH MILTON WATERS

£700–£800 per annum and a grant can be made towards expenses if necessary. Applications should be sent to the Honorary Secretary of the Association of Anæsthetists of Great Britain and Ireland, 45 Lincoln's Inn Fields, London, W.C.2, not later than June 1st.

. . . . .

We herewith offer our unqualified apologies for the unfortunate mistake in our January number when Dr. Waters' photograph appeared over the legend " Gilbert Brown ". We can only hope (vain hope, we are afraid) that Dr. Waters is a vain man, sufficiently vain in fact to prefer his photograph appearing even if wrongly named than to its not appearing. He knows his friends will not be misled and for the rest of us the mistake is being rectified in this issue before the misnamed one has created an indelible impression. As for Dr. Gilbert Brown, though he would be the last to wish to appear in a false guise of any sort, yet if a mistake had to be made, it is impossible to imagine that he could have chosen a more distinguished representative than his American counterpart.

One of our colleagues who met Dr. Brown some years ago, told us that whilst reading the article about him he came across his photograph and said to himself, " Seems to me Brown has changed a good deal." However well versed we may be in the work of our distinguished colleagues, it is not always possible to make their personal acquaintance. If the subjects of future articles would be good enough to write their names on the back of photographs this mistake should not occur again.

POST-OPERATIVE CHEST COMPLICATIONS FOLLOWING OPERATIONS FOR APPENDICITIS IN CHILDHOOD

By P. P. RICKHAM

THERE is little reference in the literature to post-operative pulmonary complications in children; the impression given is that such complications are rare in pædiatric surgery. This article is based on an investigation of a series of 909 consecutive operations for appendicitis performed on children under 16 years of age at Alder Hey Children's Hospital during the three years 1946 to 1948 inclusive. Although several series of cases of appendicitis in children have been published during the last twenty years, none has been found giving any detailed analysis of chest complications following operations for this condition. The surprising fact emerging from the present investigation is the unusually high incidence of "post-operative chests". It must be stated, however, that the majority of these operations were emergency procedures, and that a large number of anæsthetics were given by House Physicians relatively unskilled in the administration of anæsthetics.

Of the 909 patients, 71 suffered from some chest complication post-operatively. A summary of these is shown in Table I. It should be added that every pathological chest condition, however slight, has been recorded and included in this table. The 20 cases of simple bronchitis were diagnosed by a slight cough and some rhonchi on auscultation. The large number of consolidations of one or

TABLE I

Showing the nature of chest complications in 909 consecutive cases of operations for appendicitis in children

Complications	Number	Percentage of total number
Simple bronchitis	20	2.20
Broncho-pneumonia	2	0.22
Consolidation R.L.L.	10	1.10
,, L.L.L.	17	1.87
,, R.M.L.	2	0.22
,, both bases	5	0.55
Collapse R.L.L.	6	0.66
,, L.L.L.	5	0.55
,, R.M.L.	1	0.11
Lung abscess	1	0.11
Empyæma	2	0.22
Total	71	7.81

more lobes (a total of 34) were all diagnosed on clinical and radiological evidence. Usually, repeated pictures were taken to show the progress of the disease. The same holds good for the 12 cases of pulmonary collapse. There was one lung abscess and two cases of empyæma, which will be discussed in more detail later. The total percentage of chest complications was 7.81, which is much higher than the number of chest complications recorded in most large series of appendicectomies in adults. For instance, Morse and Rader (1940) reporting 8,727 cases of appendicectomies of all ages found post-operative respiratory complications in only 1.35 per cent of the 6,641 appendicectomies performed under general anæsthesia, and only 0.1 per cent respiratory complications in the 1,900 appendicectomies performed under spinal anæsthesia. Jennings (1942) reported only 25 cases of pulmonary complications following 1,680 consecutive appendicectomies, and the same low incidence of res-

piratory complications is described by several other workers. All these articles, however, mention only the more severe grades of post-operative chest complications, and undoubtedly the percentage would be much higher if they had included every case of bronchitis, however slight. The only similar series in children which could be found in the literature is that of Allen in 1937. He reported on 612 consecutive operations with 26 pneumonias and 2 empyæmas. There were 3 deaths due to chest complications. His figure for the most severe chest complications, 4.7 per cent, is in the same range as the 5.5 per cent in the present series. It seems, therefore, that post-operative complications in children are much more common than has been realized, and certainly more common than in adults.

FACTORS WITH A POSSIBLE AETIOLOGICAL BEARING

In order to study all the factors which might have a possible ætiological bearing on the production of post-operative chest complications, the following details have been compiled from this series.

TABLE II

Showing the number of operations performed and the frequency of post-operative chest complications in the different age groups

Age years	Number of appendicectomies	Number of chest complications	Percentage of chest complications
1–6	161	10	6.2
7–12	552	52	9.4
13–15	196	9	4.6
Total	909	71	7.8

Age. Table II shows the cases grouped according to age into three categories. This grouping makes the most of such

difference as there is in the age incidence of complications in the whole series. The differences are not statistically significant.

Sex. Of the 909 patients 533 were boys and 376 girls, which is slightly less than a proportion of 3 to 2. The total number of patients who suffered from chest illness after operation was 71, of whom 51 were boys and 20 were girls. The percentage incidence among boys was thus 9.6 and among girls 5.3. This is not a significant difference.

Pre-operative Respiratory Disease. Sixty-eight of the 909 patients operated upon were admitted to hospital suffering from some sort of respiratory infection varying in severity from nasopharyngeal catarrh to basal pneumonia. In the latter cases acute peritonitis was usually present. Of these 68 patients 19 subsequently presented signs of persistent chest infection, an incidence of 28 per cent. The 841 patients who had no previous respiratory infection were correspondingly less afflicted post-operatively. Only 52 of these developed chest trouble, an incidence of 6.2 per cent. In spite of the "skewness" of distributions these figures can be compared and the difference is found to be highly significant. Perhaps this is not surprising.

Seasonal Incidence. Table III shows the monthly attack rate of chest complications. If these figures are arranged in two groups whose centres correspond with the summer and winter months a highly significant difference in mean attack rate is encountered. In the period November to May the incidence is 10.5 per cent, whilst in June to October it is nearly 4 per cent. Patients admitted during the winter months are more likely to have pre-operative respiratory disease and perhaps are not in such good general condition as those admitted towards the end of summer.

TABLE III

Showing the number of operations performed and the number of post-operative chest complications during each month of the year

Month	Number of appendicectomies	Number of chest complications
January	83	6
February	63	8
March	83	8
April	72	8
May	60	7
June	75	4
July	58	0
August	73	2
September	74	3
October	97	6
November	100	12
December	71	7

Anæsthetics. The majority of operations were performed with open ether as an anæsthetic. Out of a total of 909, 30 children had thiopentone, 18 had trichlorethylene, oxygen and nitrous oxide, and 6 very ill children had only local procaine. If we consider the 71 chest complications we find that 66 had open ether, 1 had thiopentone, 2 had trichlorethylene and in 2 local anæsthesia was used. The number of anæsthetics other than open ether used is so small that the contribution, if any, of different anæsthetic agents to the causation of chest complications, cannot be deduced.

Severity of Appendicitis. Three hundred and twenty-eight of the patients had perforated appendices and 35 (10.7 per cent) of these developed chest complications after laparotomy. This ratio exceeds significantly the 7.8 per cent found for the whole series. The types of complication are shown in Table IV, where it will be seen that nearly 75 per cent of the complications found were serious. These findings bear out the hypothesis, adverted to earlier, that serious

TABLE IV
Showing the number and nature of chest complications in 328 cases of operations for perforated appendix

Complications	Number	Percentage of total
Simple bronchitis	10	28.5
Broncho-pneumonia	2	5.8
Consolidation	16	45.6
Collapse	5	14.3
Lung abscess	1	2.9
Empyæma	1	2.9
Total	35	100.0

inflammation below the diaphragm predisposes to serious post-operative complications above.

MORTALITY

The total number of deaths in this series of 909 operations was 14, a mortality of 1.5 per cent. There were no deaths amongst the 581 operations for simple appendicitis. All the deaths occurred amongst the 328 cases of appendicitis with perforation. The mortality rate compares very favourably with other series reported in the literature. Norris (1946), reporting a series of 960 operations for appendicitis in children, had a mortality of 4.75 per cent for the non-perforated and of 17 per cent for the perforated cases. Green and Watkins (1940) found that although the overall mortality for all age groups was 2.89 per cent, the mortality for children under 10 years was much higher. The death rate was 5 per cent at the age of 8 years, 15 per cent at the age of 5 years, and 35 per cent at the age of 2 years. Potts (1938), reporting a series of 92 appendicectomies performed in childhood, showed a mortality of 1 per cent for simple and 16.3 per cent for ruptured appendices. Jennings's

(1942) mortality for appendicectomy in childhood was 4.72 per cent and Anderson's (1944) mortality under the age of 3 years was 3 per cent. The low mortality in the present series bears out the statement of Schullinger (1947) that the mortality following appendicectomy has been rapidly falling in the last few years. Of our 14 deaths only one had a chest complication (empyæma) which was partly responsible for his death.

TREATMENT

The standard treatment for the more severe chest complitions was chemotherapy and breathing exercises. Of the 12 cases of collapse only one needed bronchoscopic suction, all others re-expanded quickly without that treatment.

CASE REPORTS

(1) *Post-operative Lung Abscess. Recovered.*

A girl aged 10 years was admitted with a three-days history of abdominal pain and vomiting. Chest clear. The diagnosis was an appendix abscess. The appendix was removed and the abscess drained on the day of admission. She was very ill after operation and needed intravenous fluids. She then developed an intraperitoneal abscess, which drained, three weeks after admission. Following the operation she had two pints of blood. Four weeks after admission she complained of sudden pain in the right chest, coughed up foul-smelling sputum and had signs of consolidation at the right base. Radiological examination showed a right-sided pleural effusion and several abscess cavities in the right lower lobe. The child was put on systemic penicillin and had postural drainage and breathing exercises. The abscesses emptied into the bronchus and cleared up very

satisfactorily without operative treatment. On discharge three months after admission the chest X-ray was normal. Culture of sputum yielded penicillin-sensitive non-hæmolytic streptococci and M. catarrhalis.

(2) *Post-operative Empyæma following Subphrenic Abscess. Recovered.*

A girl aged 3 years was admitted with a history of abdominal pain and vomiting for 24 hours. Chest clear. The diagnosis was general peritonitis. The appendix was removed and the peritoneal cavity drained. Two weeks later she developed a right subphrenic abscess. This was drained extrapleurally. She then developed a right-sided empyæma, which was drained. Her recovery was satisfactory. When discharged two months after admission the radiographs showed the chest to be quite clear. Pus from the empyæma grew pure B. coli on culture.

(3) *Post-operative Empyæma, Subphrenic Abscess and Fæcal fistula. Died.*

A girl aged 8 years was admitted with a history of abdominal pain and vomiting for three days. On admission she was very ill and had fæculent vomiting. The diagnosis was general peritonitis. The appendix was removed and the peritoneal cavity drained. She was very ill after operation and needed intravenous fluids. Ten days later X-rays of the chest showed consolidation of the right lower lobe. Thirteen days after admission X-rays showed a right-sided pleural effusion with a fluid level. The effusion was aspirated. There were many mixed organisms in the fluid, but the culture yielded no growth. Two days later aspiration yielded 300 ml. of pure B. coli pus. Seventeen days after admission she developed a left-sided pleural effusion, which was aspirated.

Nineteen days after admission she developed a fæcal fistula in the right iliac fossa. The right empyæma was drained by rib resection a week after aspiration and it only then became evident that she also had a right subphrenic abscess which was drained extrapleurally. She had two pints of blood post-operatively. She died of toxæmia and heart failure 4 weeks after admission.

SUMMARY

A series of 71 chest complications following 909 consecutive operations for appendicitis in children is analysed. There is a surprisingly high incidence of post-operative respiratory complications in children suffering from appendicitis. Possible ætiological factors are discussed and analysed. One case of lung abscess and two cases of empyæma following operation are discussed in more detail.

I should like to thank Miss Isabella Forshall, F.R.C.S.E., for her kind help and advice with regard to the preparation of this paper. Dr. F. J. Prime's help with the statistical part of this paper has been most valuable.

REFERENCES

Allen, P. D. (1937), *J. Amer. med. Ass.*, **109**, 121.
Anderson, S. G. (1944), *Med. J. Aust.*, **2**, 567.
Green, H. W., and Watkins, R. M. (1940), *Surg. Gynec. Obstet.*, **83**, 613.
Jennings, E. J. (1942), *Arch. Surg.*, **44**, 896.
Morse, L. J., and Rader, M. J. (1940), *Ann. Surg.*, **111**, 213.
Norris, W. J. (1946), *West. J. Surg.*, **54**, 183.
Potts, W. J. (1938), *Amer. J. Dis. Child.*, **55**, 511.
Schullinger, R. N. (1947), *Ann. Surg.*, **126**, 448.

ANÆSTHESIA WITH METHYL-N-PROPYL ETHER

WITH SPECIAL REFERENCE TO THE CHANGES IN THE ELECTROCARDIOGRAM AND BLOOD SUGAR

By A. R. HUNTER

METHYL-N-PROPYL ETHER, which is an isomer of ordinary di-ethyl ether, has been used quite extensively both in man (White et al., 1946; Carr et al., 1947; Fisher and Whitacre, 1947; Rochberg, 1947; Shane, 1947) and animals (Krantz et al., 1946) for the production of general anæsthesia. At the time at which this drug was introduced it seemed that it might have a fairly wide application in clinical work. The need for lipoid soluble anæsthetics has, of course, been greatly reduced since the general adoption of curarization as a means of producing abdominal relaxation. None the less, it seemed that it might be of interest, if not of immediate practical value, to investigate the effect of methyl-n-propyl ether on the rhythmicity of the heart and on the blood sugar.

Methods. A series of patients undergoing a variety of surgical procedures (Table I) were premedicated with 1/3 gr. (22 mg.) of omnopon and 1/300 gr. (0.2 mg.) of scopolamine. They were anæsthetized by the intravenous injection of 1.0 g. of Kemithal (sodium cyclohexenyl allyl barbiturate). Anæsthesia was maintained with nitrous oxide and oxygen in the proportions of 6: 2 and to this methyl-n-propyl ether vapour was added. The amount of oxygen was increased as the anæsthesia deepened and during some of

the operations oxygen alone was finally used as the vehicle for the vapour.

TABLE I

Case No.	Operation	Duration of Anæsthesia (minutes)
1.	Paramedian Appendicectomy	40
2.	Hysterectomy	50
3.	Paramedian Appendicectomy	40
4.	Do. do.	20*
5.	Do. do.	20†
6.	Do. do.	40‡
7.	Subtotal Thyroidectomy	60
8.	Removal Toxic Adenoma of Thyroid	40
9.	Removal Parotid Tumour	30
10.	Do. do.	35
11.	Removal Simple Adenoma of Thyroid	30

* Relaxation inadequate—change to di-ethyl ether after 20 minutes.
† Relaxation inadequate—patient curarized after 20 minutes.
‡ Relaxation only barely adequate when anæsthesia was carried beyond the point of respiratory arrest.

A standard Cambridge electrocardiograph was employed and recordings of the ordinary leads I, II and III were made before anæsthesia was induced. Thereafter only lead II was used. Records were made after giving the Kemithal and at various phases during the anæsthesia. An attempt was made in each of the cases studied to obtain a record under the deepest anæsthesia which could be produced. For this purpose narcosis was carried to the point of respiratory arrest in 2 cases.

Blood sugar determinations were carried out by the Maclean method on specimens of oxalated blood. These estimations were made within 2 to $2\frac{1}{2}$ hours of withdrawal.

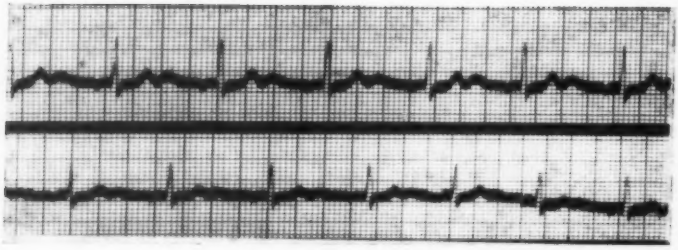


FIG. 1

A–V Nodal Rhythm during Anæsthesia with Methyl-n-propyl Ether. (Lead II Records)

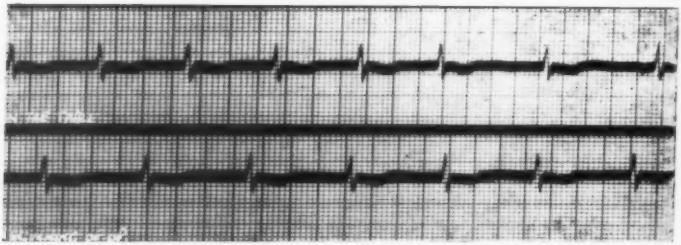


FIG. 2

Irregularity of Supraventricular Origin during Anæsthesia with Methyl-n-propyl Ether. (Lead II Records)

A.R.H.

RESULTS

Cardiographic Studies. In all, 36 records were made from 4 patients. There were no abnormalities of rhythm in the initial records nor were any observed after the Kemithal. No premature beats of ventricular origin were seen in any of the tracings. One patient had a displaced pacemaker early in the anæsthetic (Fig. 1), a finding which is of no particular significance. Another patient whose P-waves were unfortunately too flat to give any indication of auricular activity developed an irregularity during anæsthesia but her ventricular complexes remained unchanged in form (Fig. 2). Further, this woman's initial electrocardiogram indicated a considerable degree of myocardial damage and she may well have been subject to attacks of paroxysmal auricular fibrillation in the absence of anæsthesia. Apart from these special findings the records obtained indicate a general slowing of the heart rate under deep anæsthesia.

The conclusions to be drawn from this brief investigation would seem to be that the action of methyl-n-propyl ether on the cardiac function is unimportant. As Krantz and his colleagues (1947) have shown in animals, it has no tendency to sensitize the myocardium to the action of the sympathomimetic drugs and therefore its use is unlikely to be associated with the risk of primary cardiac failure.

Blood Sugar Changes. These are shown in the accompanying diagram (Fig. 3). The blood sugar rose during the anæsthetic in 9 out of 10 cases studied. The extent of the rise was, as would be expected from the number of factors which influence it, somewhat variable but in general its amount was about the same as would have occurred had di-ethyl ether been used (Minnitt, 1932). It is, however,

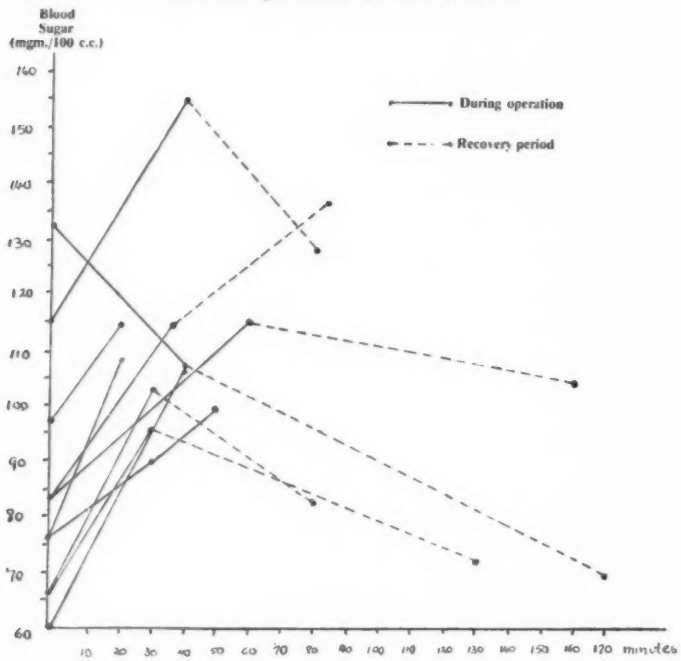


FIG. 3. The Blood Sugar during and after anæsthesia with Methyl-n-propyl Ether.

greater than that reported by Neff and Stiles (1936) after the administration of cyclopropane and less than that mentioned after a chloroform-ether mixture (Mackay, 1927).

In 5 out of the 10 cases the blood sugar was followed during the early part of the recovery period. In 4 of these it declined to a level approximating to that at which it had been before the induction of anæsthesia. In the fifth case the blood sugar rose still higher. Since it is said that the hyperglycæmia due to di-ethyl ether lasts for 24 hours or more (Mackay, 1927; Atkinson and Ets, 1922) it is possible that recovery is faster when methyl-n-propyl ether is used.

Other Observations. In the course of this investigation some incidental observations have been made on the other actions of methyl-n-propyl ether. Thus it was noted that peristalsis continued even under deep anæsthesia, that the blood-pressure might rise or fall or remain unaltered while the pulse rate was generally slow. This phenomenon was particularly noteworthy in the two cases of toxic goitre to whom methyl-n-propyl ether was given without any suggestion of the increase of heart rate which so often occurs when di-ethyl ether is given to such patients. In 2 of the 6 abdominal operations in which the drug was used abdominal relaxation was unsatisfactory and other agents had to be substituted. In a third anæsthesia had to be carried beyond the point of respiratory arrest before abdominal closure could be performed. Contrary to what has been reported by others it was found that recovery of consciousness was no more rapid than when di-ethyl ether had been used and not one of the patients from whom post-operative blood specimens were taken was fully awake.

The properties of methyl-n-propyl ether, therefore, closely resemble those of its di-ethyl isomer. It can, however, claim to be without action on intestinal peristalsis and to have little tendency to accelerate the thyrotoxic heart, but these properties are by no means unique. It is explosive and therefore cannot be used with absolute safety when the diathermy is being employed. It may fail to afford adequate abdominal relaxation and this very markedly limits its field of application. Unless this drug proves on investigation to have other properties which make it of particular value in one of the special fields of anæsthesia it can have only a small claim to be included in the armamentarium of the modern anæsthetist.

SUMMARY

The effect of methyl-n-propyl ether on the cardiac rhythm and on the blood sugar have been studied. They resemble those of di-ethyl ether in that the heart beat is little affected while the blood sugar rises quite markedly. For these and other reasons which are discussed in this paper it seems that there is little to be gained by the substitution of methyl-n-propyl ether for other agents in use at present.

I am indebted to Miss Corner, who operated the electrocardiograph; to Dr. A. Morgan Jones, who assisted me in the interpretation of the tracings; to Dr. J. C. Kerrin, in whose department the blood-sugar estimations were performed; and to Mr. N. W. Bolton, who operated on the patients. The methyl-n-propyl ether used in the investigation was generously provided by Messrs. Duncan, Flockhart and Co. Ltd.

REFERENCES

Atkinson, H. V., Ets, H. N. (1922), *J. biol. Chem.*, **52**, 5.
Carr, C. J., Farson, de C. B., Krantz, J. C. (1947), *Anesthesiology*, **8**, 53.
Fisher, A. J., Whitacre, R. J. (1947), *ibid*, **8**, 156.
Krantz, J. C., Evans, W. E., Carr, C. J., Kibler, D. V. (1946), *J. Pharmacol.*, **86**, 138.
Krantz, J. C., Carr, C. J., Iwamoto, H. K., Sauerwald, M. J. (1947), *Anesthesiology*, **8**, 497.
Mackay, R. L. (1927), M.D. Thesis, Glasgow.
Minnitt R. J. (1932), *Proc. Roy. Soc. Med.*, **26**, 347.
Neff, W. B., Stiles, J. A. (1936), *J. Canad. med. Ass.*, **35**, 56.
Rochberg, S. (1947), *Anesthesiology*, **8**, 637.
Shane, S. M. (1947), *Anesth. & Analges.*, **26**, 260.
White, L. T., Shane, S. M., Krantz, J. C. (1946), *Anesthesiology*, **7**, 663.

METHYL-N-PROPYL ETHER

By G. J. REES *and* T. CECIL GRAY

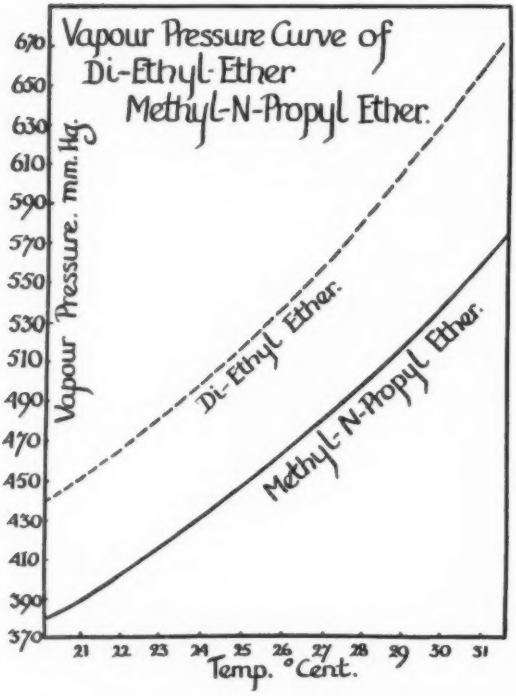
METHYL-N-PROPYL ETHER is an isomer of di-ethyl ether and possesses the formula CH_3–O–$(CH_2)_2$–CH_3. The physical properties of the two drugs are similar, and the vapour pressure curve of methyl-n-propyl ether is such that it may be used in the Oxford Vaporizer No. 1 without any alteration in the calibration of the instrument (see Figure).

Methyl-n-propyl ether has a very unpleasant pungent odour. This was found to prevent its use as an analgesic agent for women in labour, and it is unpleasant in operating theatres when the drug is administered in open circuits as an anæsthetic agent.

The use of methyl-n-propyl ether as an anæsthetic agent was first described in 1946 by White et al. This paper is based on the experiences of the authors in a small series of twenty cases in which it was used as an anæsthetic agent. The series is small but was abandoned when it was appreciated that the drug had no outstanding advantages. In none of these cases was the drug used in combination with any of the muscle relaxant drugs, as it was our intention to investigate the basic effects of the ether, and not to develop a technique for its use.

ANALGESIC EFFECTS

Methyl-n-propyl ether produces a remarkable degree of analgesia without loss of consciousness. This was discovered when trying to assess the degree of recovery in one of the patients by pressure on the supra-orbital nerve. The patient



Graph showing the vapour pressure curves of di-ethyl and methyl-n-propyl ether. It will be seen that at the operating temperature of the Oxford Vaporizer No. 1 the vapour pressures are 605 mm. Hg and 515 mm. Hg respectively. Therefore if the machine is used with methyl-n-propyl ether the vapour concentration delivered will be the percentage shown on the di-ethyl ether calibration $\times \frac{515}{605} = .85$ (approx.) which, for practical purposes, over the range of the machine may be regarded as 1.

tolerated this very painful stimulus without sign of discomfort, although able to phonate.

As a result of this observation, experiments were carried out on volunteers to see if practical use could be made of this property of the drug. The experiments consisted of the inhalation of the vapour from one of the standard obstetrical analgesia inhalers commonly used to administer trichlorethylene. The stimulus used was the application of a cross-action towel clip to the skin of the fore-arm. It was found possible to carry out this procedure without discomfort under the analgesic effect, but without this the pain was hard to tolerate.

As a result of these findings one of our colleagues exhibited the vapour to women in labour, but the unpleasant odour of the drug caused it to be unacceptable to these patients.

INDUCTION OF ANAESTHESIA WITH METHYL-N-PROPYL ETHER

As compared with di-ethyl ether the induction of anæsthesia with methyl-n-propyl ether is smooth, both with nitrous oxide-oxygen-ether and with thiopentone-ether sequences, and with open-drop administration.

Using a standard Boyle's machine it has been found possible in all but the most refractory cases to change over from thiopentone narcosis to the full vapour concentration of methyl-n-propyl ether which the machine will deliver without bubbling the gases through the liquid, in three quite short stages, and this without any signs of intolerance of the vapour on the part of the patient.

It has also been found quite feasible to administer the drug from the ether vaporizer of the Coxeter-Mushin circle absorber following a normal induction dose of thio-

pentone, without any intermediate saturation of the patient with a nitrous oxide-oxygen mixture, a feat which is difficult to perform with di-ethyl ether.

MAINTENANCE OF ANAESTHESIA

General Remarks. Endotracheal intubation is readily performed under methyl-n-propyl ether anæsthesia. It is possible to maintain a light plane of anæsthesia with it more smoothly and with less risk of untoward occurrences than is the case with di-ethyl ether. This is illustrated by Case No. 3, where the patient was conscious and talking during the recovery period, but at the same time tolerating a Waters metal airway without any retching!

Relaxation. The drug has been found to be most unsatisfactory for those operations which call for more than the minimal amount of muscular relaxation. Spasm of the laryngeal muscles or of the masseter was not seen in any of the cases.

Respiratory Effects. In light planes of methyl-n-propyl anæsthesia the respirations are quiet and slow. This depression of the respiration is never so marked as that seen during cyclopropane anæsthesia, and the rate appears to be more affected than the depth of respiration. When an attempt is made to produce any great degree of muscular relaxation by increasing the concentration of the ether, the respiration becomes extremely rapid. Unlike the tachypnœa of deep trichlorethylene anæsthesia, the tidal volume remains fairly high. This tachypnœa, combined with the poor muscular relaxation, produced difficult operating conditions and evoked many complaints from surgeons.

Cardiovascular Effects. The colour of patients anæsthe-

tized with methyl-n-propyl ether indicates a degree of vasodilatation. They are pink, flushed, and usually sweat freely at deeper levels of anæsthesia.

The pulse rate is not greatly affected but the effect on the blood-pressure is very marked. Alarming degrees of hypotension have been seen when attempts have been made to procure muscular relaxation by deepening anæsthesia (Fisher and Whitacre, 1947). In such cases a change to di-ethyl ether was accompanied by an immediate improvement in cardiovascular function. This improvement has been taken to indicate that the depression was due to the ether and not to incidental causes.

Recovery. The recovery from light anæsthesia with this agent has been very pleasant. The major cases all required supplementation with di-ethyl ether so that the recovery has been as from that drug.

The remarkable analgesic properties of the drug have been observed during recovery of patients from anæsthesia. Two of the cases demonstrated this very clearly. The first was a man of fifty-four who had been operated on for the excision of a hydatid of Morgagni. This man recovered consciousness to such a degree that he was able to carry on a coherent conversation before the suturing of the scrotal incision was complete. He made no complaint of any discomfort, even when interrogated, whilst the operation was being completed.

The second case which demonstrated this effect was a female who had been operated on for the radical cure of varicose veins. She opened her eyes shortly after the completion of the operation, and was asked how she felt. She replied that she felt very good, and her smile showed that this was no exaggeration, despite the fact that she still retained a Waters-type metal airway in her pharynx.

CASE RECORDS

The following specimen records of cases illustrate some of the properties of methyl-n-propyl ether when used as an anæsthetic agent. The incidence of vomiting is noted but, as would be expected from the nature of the operative procedures, no post-operative pulmonary complications were encountered.

Case No. 1

M. N., male, aet. 44. Renal calculi.
Operation performed: Nephrolithotomy.
Pre-operative B.P.: 130/90.
Premedication: Morphia gr. 1/6 (11 mg.) and atropine gr. 1/100 (0.65 mg.) given one hour before operation.
10.45: Thiopentone 0.5 g. administered slowly. Put on closed circuit with CO_2 absorption and pure oxygen, 300 ml. per minute Methyl-n-propyl ether introduced to circuit from vaporizer.
10.50: Oro-tracheal intubation easily performed. Oral pack—facepiece re-applied.
10.55: B.P. 120/85. Operation started.
11.05: B.P. 100/70. Respirations 30 per minute. Surgeon complained of poor relaxation. Airway good.
11.15: B.P. 90/60. Surgeon still complains of poor relaxation. Respirations 35 per minute. Change to di-ethyl ether and cyclopropane.
11.20: B.P. 130/85. Respiration quiet, relaxation improving.
11.30: B.P. 110/75.
11.45: B.P. 125/80. Operation completed. Reflexes present in theatre. Vomited once on return to ward.

Case No. 2

A. P., male, aet. 52. Renal calculi. Chronic bronchitis.
Operation performed: Nephrolithotomy.
Pre-operative B.P.: 160/80.
Premedication: Morphia gr. 1/6 (11 mg.) and atropine gr. 1/100 (0.65 mg.).
Induction: Thiopentone 0.5 g. at 10.58 N_2O 4 l. per minute, O_2 2 l. per minute. Methyl-n-propyl ether introduced to gases from vaporizer. Some coughing during induction.
11.00: B.P. 130/70.
11.05: B.P. 150/90. Intubation easily performed, no reaction to tube—mouth packed, rapid recovery and coughing on tube before mask could be replaced. Quickly re-stabilized.

11.10: B.P. 160/90. Moved into theatre.
11.15: B.P. 110/65. Respirations 28 per minute.
11.20: B.P. 92/60. Respirations 30 per minute. Positioned in kidney position. Bridge up.
11.25: B.P. 90/55. Respirations 30 per minute. Incision made. Respiration assisted with view to control. Pulse good in volume. Anæsthesia lightened.
11.30: B.P. 100/60. Pulse 90.
11.32: Breathing rather gasping in type.
11.35: B.P. 120/80. Pulse 92. Respirations 48 per minute (quite deep).
11.40: B.P. 120/90. Pulse 96. Respirations 42 per minute.
11.42: Surgeon complains of lack of relaxation. Anæsthesia deepened.
11.45: B.P. 110/90. Pulse 100. Respirations 40 per minute.
11.46: Hiccough a nuisance.
11.49: Cyclopropane 400 ml./min. added.
11.50: B.P. 142/90. Pulse 92. Respirations 35. Respiration irregular with hiccoughs. Change to di-ethyl ether.
11.55: B.P. 130/85. Pulse 90. Respirations 30.
12.00: B.P. 127/80. Pulse 104. Respirations 40.
12.05: B.P. 124/82. Pulse 96. Respirations 35. Operation completed. Reflexes not back in theatre. Seen one hour later, full consciousness and comfortable.

Case No. 3

A. P., female, aet. 30. Varicose veins. Trendelenburg operation.
Pre-operative B.P.: 120/90.
Premedication: Morphia gr. 1/6 (11 mg.) and atropine gr. 1/100 (0.65 mg.).
Induction: Thiopentone 0.4 g. N_2O 4 l. per minute, O_2 2 l. per minute. Methyl-n-propyl ether started.
Duration of operation: 20 minutes. Breathing slow throughout (12 per minute). Pulse regular. B.P. fell to 90/80. Rapid recovery. Patient tolerated Waters pharyngeal airway after recovery to consciousness. No vomiting. In this case at one time there was a noticeable waxing and waning of the pulse with respiration.

Case No. 4

E. M., female, aet. 36. Hæmorrhoids.
Operation performed: Hæmorrhoidectomy.
Pre-operative B.P.: 130/90.
Premedication: Morphia gr. 1/6 (11 mg.) and atropine gr. 1/100 (0.65 mg.).
Induction: Thiopentone 0.5 g. N_2O, O_2, methyl-n-propyl ether. At time of dilatation of sphincter B.P. 100/70, laryngeal

crow occurred. Anæsthesia lightened after dilatation and maintenance was smooth with respirations at 14 per minute.

Recovery time: 10 minutes. No vomiting.

Case No. 5

M. C., male, aet. 55. Hydatid of Morgagni. Bronchitis.

Operation: Exploration of testicle.

Pre-operative B.P.: 140/100.

Premedication: Morphia gr. 1/6 (11 mg.) and atropine gr. 1/100 (0.65 mg.).

Induction: Thiopentone 0.5 g. N_2O, O_2, methyl-n-propyl ether. Induction difficult with coughing, laryngeal spasm and cyanosis. Operation lasted 30 minutes. Some tachypnœa and tachycardia. B.P. fell at one point to 100/70 and the ether was withdrawn. Recovery was very rapid and patient was talking and moving as the skin was being sutured, but complained of no pain, even on interrogation, and demonstrated clearly the analgesic properties of methyl-n-propyl ether.

Case No. 6

G. T., male, aet. 30. R.I.H. Radical cure.

Premedication: Morphia gr. 1/6 (11 mg.) and atropine gr. 1/100 (0.65 mg.).

Induction: Thiopentone 0.5 g.

Maintenance: Closed circuit methyl-n-propyl ether. Induction smooth, maintenance satisfactory, respirations 18 per minute throughout, pulse volume good throughout.

Recovery time: 10 minutes following withdrawal of ether. Vomited once on return to ward.

Case No. 7

F. S., female, aet. 32. Laparotomy.

Operation performed: Oophorectomy.

Pre-operative B.P.: 125/85.

Premedication: Morphia gr. 1/6 (11 mg.) and atropine gr. 1/100 (0.65 mg.).

Induction: Thiopentone 0.5 g. at 10.15 a.m.

Maintenance: N_2O–O_2–methyl-n-propyl ether.

10.25: Operation commenced. B.P. 115/75. Trendelenburg position.

11.35: Relaxation poor, anæsthesia deepened.

11.45: B.P. 105/70. Respirations becoming shallower. Apnœa—artificial respiration by compression of bag filled with O_2 only.

11.50: Return of spontaneous respiration.

11.55: Operation completed. Vomited twice on return to ward.

Case No. 8

N. A., male, aet. 2. Varicose veins.
Operation performed: Radical cure.
Premedication: Morphia gr. 1/6 (11 mg.) and atropine gr. 1/100 (0.65 mg.).
Induction: Thiopentone 0.5 g. N_2O, O_2, methyl-n-propyl ether. Maintenance satisfactory—respirations 16 per minute throughout.
Recovery time: 6 minutes. No vomiting.

CONCLUSIONS

There appears to be only one outstanding and possibly valuable property exhibited by methyl-n-propyl ether as opposed to the di-ethyl homologue. That is the well-marked state of analgesia which it produces in low concentrations. This property could not be utilized to produce analgesia in conscious patients because the odour makes the drug unacceptable to them. It might, however, give the drug a certain value in a balanced anæsthetic when a relaxant is used to complete the triad of relaxation, narcosis and analgesia.

In anæsthetic practice it could never supplant di-ethyl ether as the "universal drug". It could be used satisfactorily in minor surgery, but possesses no properties which would make it more useful than trichlorethylene for such purposes.

Our thanks are due to Messrs. Duncan, Flockhart and Co. Ltd. who supplied the material for these trials.

REFERENCES

Fisher and Whitacre (1947), *Anesthesiology*, **8**, 156.
White et al. (1946), *Anesthesiology*, **7**, 663.

A PRELIMINARY REPORT ON THE ANÆSTHETIC PROPERTIES OF ISO PROPYL CHLORIDE

By THOMAS J. C. MACDONALD

AS a result of a pharmacological investigation into the anæsthetic properties of various halogen derivatives of the aliphatic hydrocarbons, I was impressed by the possibilities of the propyl chlorides. Closer scrutiny of the toxicity of these two showed that the isomer was superior to the normal.

Iso propyl chloride (CH_3 CH Cl CH_3) is a colourless liquid with a slightly musty odour. It has a boiling point of 36.5°C: specific gravity 0.8588 at 20.6° C: molecular weight 78.54: solubility in water 0.308 g. in 100 ml. at 20°C: freely soluble in ether and oil. It burns readily with a greenish-yellow flame, slightly smoky, and gives off a sweet propyl-like odour. There are numerous methods of manufacture. Commercially, the easiest method is by the action of hydrochloric acid on iso propyl alcohol, in the presence of zinc chloride. The iso propyl chloride is distilled from the mixture, washed free from acid, dried and finally purified by distillation.

Iso propyl chloride is in general comparatively stable when properly stored. On exposure to air and light, oxidation and slight decomposition can be detected only after three months. This would be expected in this type of alkyl halide. Storage in small dark glass containers is therefore necessary. When passed over soda lime, heated to a moderate temperature such as would be experienced in a

closed circuit apparatus, preliminary experiments did not show any decomposition.

The pharmacological investigation consisted of the action of the agent on striped muscle, heart, and the depressive effect of various partial pressures in air on a rabbit, and the effects of various sub-anæsthetic and anæsthetic partial pressures on the blood-pressure and respiration on a decerebrate preparation.

Satisfied with the results of these investigations, and after numerous administrations to rabbits by the same method as would be used in the first instance in man, which had no deleterious effect of any kind and were followed by a rapid recovery, I considered that this substance possessed a large margin of safety and was worthy of trial on the human subject. I first administered iso propyl chloride to a human subject by the drop method on an open Ogston's mask. There was some excitement exhibited by the patient as the second stage was reached. This, I concluded, was due to my failing to push the second stage with the usual rapidity. First-plane third-stage anæsthesia was very easily reached and smoothly maintained. There was no coughing, salivation, irritation of the respiratory tract, or marked cardiac upset. In this respect, this substance was reacting like the other aliphatic halogens in present use. Recovery occurred within a few minutes of the cessation of the administration. The total time of anæsthesia was 20 minutes. It was used successfully by this method for the dressing of three cases of compound fracture of the leg. Post-anæsthetic history showed nothing unusual. There was no sickness, nausea, giddiness, no jaundice or liver disturbances of any kind, no cardiac or respiratory upset. These results were so encouraging that further trials were considered advisable. A further series of 14 cases combining iso propyl

chloride with nitrous oxide and oxygen in a Boyle's apparatus were carried out. A summary is appended below.

Number of Cases .	14.
Sex . . .	Male and female.
Age . . .	13 to 78 years.
Types . . .	Thin, nervous and apprehensive to healthy and robust.
Premedication . .	Morphine sulphate gr. 1/6 (11 mg.). Atropine sulphate gr. 1/100 (0.65 mg.). (except the 13-year-old who had Atropine only).
Operative Time .	5 minutes to 1 hour.
Anæsthetic . .	Nitrous oxide and oxygen. Iso propyl chloride. Used in the present-day type of Boyle's apparatus.
Induction . .	Rapid in all cases with a tendency to excitement in some as the second stage was reached. There was no coughing, salivation, stridor, spasm, accelerated breathing, or cardiac irregularities. There was noticeable bradycardia in the longer operations with greater depths of anæsthesia. Colour remained pink throughout. There was no lowering of the amplitude of the tidal air. Insertion of an air-way at a light level of anæsthesia did not predispose to laryngeal spasm.
Recovery . .	In all cases within a few minutes, as if the patient were waking up from a sleep.
Post-anæsthetic .	There was occasional nausea experienced but no vomiting; no headache, giddiness, visual disturbances; no cough; no jaundice. The patients were able to enjoy their meals shortly after recovery.

Blood-pressure .	There was no marked alteration in the blood-pressure throughout the administration.
Operative Procedures	Amputation of leg. Menisectomy (3 cases). Tendon suture (2 cases). Incision and packing breast abscess. Cystostomy (2 cases). Incision and drainage of post-auricular abscess. Manipulation and plaster to leg. Incision and packing of neck abscess. Reduction and plaster—Potts fracture. Bilateral hallux valgus.

One particular quality which iso propyl chloride demonstrated from the above cases was a protracted analgesia which I have not seen with any other agent. In view of this fact, a further series of cases was conducted for instrumental deliveries and repair of lacerations, where the plane of anæsthesia was at the lightest possible limit which would facilitate the surgeon in his work and have no deleterious effect upon mother and child. A summary is appended below.

Number of Cases .	24.
Age . . .	18 to 47.
Parity . .	Primiparae to para-8.
Premedication .	Varied considerably with the individual. Atropine sulphate, 12 cases. Pethidine and atropine sulphate, 6 cases. Morphine sulphate, 1 case. Morphine sulphate + atropine sulphate, 1 case. Atropine sulphate + sodium gardenal, 1 case. No premedication, 3 cases.
Operative Time .	15 minutes to 1 hour, 25 minutes.

Anæsthetic . .	. Nitrous oxide, oxygen and iso propyl chloride used with the present-day type of Boyle's apparatus.
Level of Anæsthesia	. Very light first-plane third stage to second-plane third stage.
Induction . .	. Smooth, without any subjective upset.
Operative Procedures	. Forceps deliveries, 16 cases. Craniotomy, 1 case. Perforation, 1 case. Forceps delivery with manual removal of placenta and extensive repair of cervical laceration, 2 cases. Breech delivery—twins, 1 case. Assisted breech delivery with manual removal of placenta, 1 case. Retained placenta, 1 case. Examination under anæsthesia, 1 case.
Blood-pressure .	. There was no marked alteration in the blood-pressure throughout the administration.
Recovery . .	. Rapid.
Post-anæsthetic .	. One case had sickness with food vomit. One case had nausea with retching but no vomit. Remainder had no headache, no sickness, no giddiness or visual disturbances, no cough or jaundice. Patients were able to enjoy their meals after recovery.

As a result of the examination of the above cases, I was still more impressed by the analgesia produced by this agent. I felt it could have a place in anæsthesia, particularly in obstetrics and painful post-operative dressings, where pain could be minimized to such an extent that it was not appreciated without the loss of co-operation of the patient and only slightly confused consciousness with intensified hearing.

None of the modern anæsthetic apparatus appeared to me to be suitable for the administration of this agent to obtain this desired analgesic effect. Consequently I designed a piece of apparatus which could safely be used to produce this inherent quality. It can be described simply as a venturi tube (A), 1 inch in diameter, cut at a 15-degree angle cone. At the centre of the waist of the venturi tube an entrainment tube (B) is inserted, $\frac{1}{4}$-inch internal diameter. Around this entrainment tube is a further sleeve (C) of 2 inches in diameter, fixed to the lid portion (D) of the container. Around this sleeve is a further sleeve (E) which screws into the lid and becomes a reservoir.

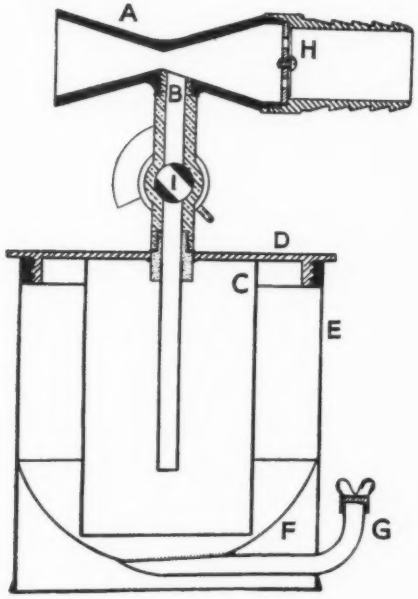


FIG. 2

Apparatus for administration of Iso Propyl Chloride as Analgesic during Labour—see text

This outer sleeve is closed with a dished bottom (F), giving adequate clearance to the inner sleeve, and set at such a pitch that as the fluid is used the cross-section area of the fluid from which vapour is entrained can never exceed the cross-section of the inner sleeve irrespective of how low the level of the fluid reached. A $\frac{1}{8}$-inch bleed hole was made in the lid allowing air to enter the inner sleeve, so as to reduce negative pressure and keep a more constant partial pressure of the vapour in the ultimate mixture. A side filler (G) permits only a maximum fluid level within the container. At the distal end of the venturi tube a light rubber non-returnable valve (H) is placed, giving unidirectional flow. Distal to this valve, flexible corrugated rubber tube with a facepiece and spring-loaded expiratory valve is fixed. At the top of the entrainment tube a cock (I) is incorporated whereby the entrainment tube could be narrowed, thus giving a lower limit control of the partial pressure of the inspired vapour in the ultimate mixture. The maximum concentration of the vapour depends upon (*a*) the size of the entrainment tube; (*b*) the surface area of the fluid from which the vapour was entrained. The minute litre volume of air passing through the venturi tube at each inspiration varies the velocity at the waist and therefore varies the amount of entrainment, but the percentage composition of the entrained gas in the final mixture remains constant.

The degree of depression from an anæsthetic agent is associated with the partial pressure of the anæsthetic vapour inhaled. In this apparatus cooling of the anæsthetic liquid takes place by latent heat of vaporization. This will lower the partial pressure in the final mixture, but against that the patient's diminishing resistance to the vapour would balance out this physical law. Consequently the vapour mixture will give a reasonably constant plane of cerebral

depression. The water-oil solubility of iso propyl chloride provides for a rapid balance of the blood-tension with the partial pressure in the inspired air. This physical property gives for rapid induction and recovery, as will be seen in the summary of cases listed below.

Number of Cases .	45.
Age . . .	18 to 39.
Parity . . .	Primiparae to para-7.
Time of Administration	Second stage of labour.
Behaviour . .	Co-operative but in some cases mildly excited, shown principally by movements, not by crying out.
Effect on Pains .	Strength not diminished. Frequency not diminished.
Condition between Pains	Drowsy. Co-operative. Hearing accentuated.
Effect on Fœtal Heart	Nil.
Procedures . .	Spontaneous delivery, 38 cases (including 2 pairs twins—1 pair alive, 1 pair S.B. abortions). Breech delivery with forceps to after-coming head, 1 case. Suture of episiotomy, 2 cases. Vaginal examination, 1 case. Pelvic examination, 1 case. Examination under anæsthesia, 2 cases.
Drugs given in First Stage	Pethidine, 18 cases. Mist., three-fifteens, 1 case. Morphine sulphate, 1 case. Sodium gardenal, 1 case. Pethidine and morphine sulphate, 1 case. Pethidine and sodium gardenal, 1 case. Omnopon, 1 case. Nembutal, 1 case. Atropine sulphate, 1 case. Paraldehyde, 1 case. No premedication, 18 cases.

Class of Child at Birth	Class A, 32. Class B, 5. Class C, 2. Abortions (twins), 2.
Reaction of patient during inhalation	No pallor; no alteration in pulse, blood-pressure or respiration; no sweating; drowsy between pains; no suffocating feeling.
After-effects . .	Round in a few minutes. No nausea; no headache; not drowsy; no retching; in most cases did not feel the baby being born, in others felt baby being born without experiencing any pain. Some cases required repair of episiotomy. They stated that they did not feel the stitches being inserted.
Effect on Uterus .	No alteration in retraction time or tone quality of the uterus.
Patients' Comments	A number complained of tingling sensation and numbness. Some who had had gas and air appreciated the greater analgesic qualities of iso propyl chloride.

CONCLUSIONS

It will be seen from the last summary of cases that iso propyl chloride possesses all the desirable properties of a true analgesic. Its inflammability must be accepted, as it is impossible chemically to have an aliphatic halogen with under three chlorines in the molecule which is non-inflammable, and with three chlorine atoms the water solubility is markedly reduced, consequently the raising and lowering of the blood-tension by inhalation of the agent is very considerably delayed, and the analgesic effect only becomes apparent when uterine contraction is well advanced.

Clinically iso propyl chloride behaves like cyclopropane. Major surgical work has not been attempted on any large

scale as yet, but from the findings to date there is no reason to think that there should be any difference in the reactions of the patients to it from cyclopropane. If, after further work, this should prove to be the case, a more convenient, portable, and less expensive material than cyclopropane could be added to the armamentarium of present-day anæsthesia.

In normal labour, the analgesic qualities facilitate the operator in conducting delivery with the patient's co-operation and freedom from pain.

SUMMARY

1. A new anæsthetic agent possessing very marked analgesic qualities is found in iso propyl chloride. Very rapid induction and excretion is found without side-effects or post-operative sequelæ. Relatively high concentrations can be inhaled without any irritant effect on the respiratory mucous membranes.

2. A new apparatus for the production of the analgesic qualities of this agent is described.

3. A new analgesic is available for use in labour, portable, easily self-administered, with rapid recovery and without sequelæ.

I am indebted to the British Drug Houses for their co-operation in the production of this agent, and to the Medical and Industrial Equipment Ltd. for the reproduction of the apparatus.

A MODIFICATION OF THE DICHROMATE METHOD FOR THE ESTIMATION OF DI-ETHYL ETHER AND ETHYL ALCOHOL

By K. D. KNOX *and* E. A. PASK

SEVERAL methods for the estimation of di-ethyl ether in blood depend upon the volatilization of the ether, which is then absorbed in a solution of potassium dichromate in concentrated sulphuric acid. It is thus oxidized to acetic acid by the dichromate. The remaining unreduced dichromate is then estimated by addition of potassium iodide, and the titration of the iodine produced with thiosulphate, using starch as an indicator (Shaffer and Ronzoni, 1923).

When attempting to use this method, great difficulty was experienced in securing definite and consistent end-points.

The addition of barium chloride before titration (Kibler, 1947) did not improve matters appreciably. Either accurate neutralization with sodium carbonate and the subsequent addition of small concentrations of hydrochloric acid, or great dilution of the dichromate sulphuric acid solution with distilled water, made consistent readings possible, but both manœuvres are inconvenient.

The remaining dichromate can also be estimated by titration with ferrous sulphate or ferrous ammonium sulphate, and methyl orange has been suggested as an indicator (Cavett, 1938). This method was tried, but agreement between gravimetric and titrated values of dichromate in concentrated sulphuric acid solutions could not be secured. Titration with potassium ferricyanide as an

external indicator did give results which agreed with weighings.

The use of the ferrous sulphate titration employing diphenyl anthranilic acid as an indicator proved convenient, and the modified method which emerged will be described.

The effects of variation in concentration of sulphuric acid, the effects of reaction temperature and reaction time upon the oxidation of the ether as far as acetic acid, and the probable loss of ether from the blood by the sampling and setting-up techniques have been investigated and an overall accuracy of ± 2 per cent seems possible in blood samples containing 50–200 mg. of ether in 100 ml. of blood.

DESCRIPTION OF METHOD

Withdrawal of Blood

Arterial or venous blood is withdrawn into a sterile all-glass syringe containing a small quantity of dry oxalate. Any bubbles are quickly expelled; the syringe is "capped" with a soldered-up needle hub, while blood is being gently expelled, so that no air is enclosed. The syringe is then rotated to mix the contents, and stored in ice. Volatile oxidizable substances are not used for cleaning the skin before the vessel puncture.

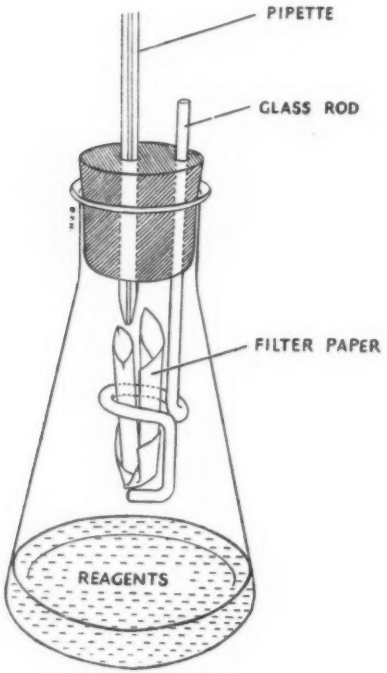
The Apparatus

This consists of a 250-ml. wide-mouthed flask carrying a twin-holed rubber bung. New flasks should stand completely filled with dichromate and sulphuric acid solution for 14 days before use.

A piece of glass rod (about 7 mm.) is bent to 90 degrees at one end. About $1\frac{1}{2}$ inches above the bend a horizontal $1\frac{1}{4}$-inch-diameter loop is formed. Above the loop the rod

forms a straight stem which fits tightly through one hole in the bung.

A filter paper approximately 10 cm. in diameter is rolled and then folded in half. It is thrust through the glass loop



Apparatus for the estimation of Di-Ethyl Ether and Ethyl Alcohol in Blood—see text

and its point of folding rests upon the 90-degree bend. The second hole in the bung is fitted with a short tightly-fitting glass rod. The rods are arranged so that the filter paper lies immediately below the second hole in the bung (see Figure).

The Method

Five ml. of approximately N/10 potassium dichromate solution and 20 ml. of 60 per cent sulphuric acid are placed in the conical flask and the bung carrying filter paper is carefully inserted. The second hole in the bung is open.

One ml. of blood is discharged from the syringe through a short rubber connector into a parallel-sided 1-ml. pipette. Spring tool-clips, screwed to the bench, have helped to hold syringe and pipette, and the pipette is inserted into the rubber connector as blood is being gently expelled from the syringe.

The filled pipette is passed through the second hole in the rubber bung of the flask and the 1 ml. of blood discharged on to the filter paper; the pipette is withdrawn and the hole immediately closed with the short glass rod.

Two procedures are then possible: either (*a*) the flasks are left at room temperature for from 24 to 36 hours, or (*b*) the flasks are incubated at 37°C. for 3 to 4 hours.

A blank flask must be set up with each batch and it will be found that about 2 per cent of titratable dichromate will usually be lost in the blank, during the incubation or waiting period.

The remaining dichromate in the sample flasks is estimated by titration with N/100 ferrous ammonium sulphate standardized against the dichromate solution. The titration is carried out in the reaction flask using 1–2 drops of the indicator, which is added near to the end-point.

The Indicator

Twenty mg. of diphenyl anthranilic acid are dissolved in approximately 20 ml. of saturated sodium hydroxide solution. The resulting solution is then diluted to 2 litres with distilled water and is filtered. It seems almost impossible to make the solution too dilute.

When the titration approaches its end-point, the indicator imparts a red colour to the solution and at the end-point this colour changes abruptly to a very pale green.

Calculation

The difference between the "blank" and sample titrations indicates the amount of dichromate reduced by the ether. The calculation is based upon the equation for the oxidation of di-ethyl ether to acetic acid.

ETHYL ALCOHOL

A few trials have been made in the estimation of known quantities of ethyl alcohol added to blood. The method seems satisfactory for this estimation, but has not been extensively tested.

SMALL-SCALE METHOD

In the bottom of a 4-inches-long and 1-inch-diameter boiling tube 1 ml. of N/10 dichromate and 5 ml. of 60 per cent sulphuric acid are carefully placed. A small filter paper is folded into a cone and is pushed half-way down the boiling tube. It retains its position by friction. Through a single hole in the tight rubber bung for the boiling tube, the pipette is thrust and 0.1 ml. of blood discharged on to the filter paper. The hole in the bung is then promptly closed with a tight glass rod, and the incubation and titration follow the course described above.

REFERENCES

Cavett, J. W. (1938), *J. Lab. clin. Med.*, **23**, 543.
Kibler, Dorothy V. (1947), *Anesthesiology*, **8**, 288.
Shaffer, P. A., and Ronzoni, E. (1923), *J. biol. Chem.*, **57**, 741 and 761.

No. 4

EMINENT ANAESTHETISTS

H. EDMUND G. BOYLE

By CHARLES F. HADFIELD

FROM descriptions often repeated, readers will be familiar with the dramatic scene which took place in the operating theatre of University College Hospital on December 21, 1846. Then it was that Liston amputated through a thigh under successful ether anæsthesia, in the presence of Erichsen, Lister, and probably Clover. The ether was administered by Dr. Squire. So impressive was the occasion that Liston could scarcely control his voice sufficiently to speak.

Within a few days, or weeks at most, similar and almost equally dramatic scenes must have taken place at all other large hospitals but I do not remember ever having read descriptions of them. From some, admittedly superficial, enquiries I have never been able to find any record as to when the first major operation under anæsthesia was performed at St. Bartholomew's, who was the surgeon, or by whom the ether was administered. Naturally, at first, no regular appointment would be made for the performance of such new duties. By 1852, however, we find that the resident Warden of the College—Dr. Patrick Black— was appointed "Administrator of Chloroform" and he was succeeded by other physicians. By 1868 the office was taken over by surgeons, the earliest of whom were Mr. John Langton and, a little later, Mr. Howard Marsh. It is of great interest to

me personally to remember that these two distinguished surgeons were still on the active staff when I entered the Hospital as a student. The following quotation is from Sir Norman Moore's *History* of the Hospital:

> ". . . at this time the administrator seems to have had an indefinite status and is not mentioned in the list of the staff till 1875, when Joseph Mills, the first man in St. Bartholomew's who made the administration of anæsthetics his sole profession, was appointed."

It was Mills who used and taught the administration of chloroform from his own special drop-bottle on to pieces of doubled lint frequently reversed. The use of this particular method was for more than a generation the means by which a "Barts" man could be recognized in all parts of the world. On his death in 1893 he was succeeded by his then assistant, Mr. Richard Gill, who continued to develop and add to his methods. He was a man of singular and somewhat eccentric character who ruled his clerks (of whom I had the advantage of being one) with a rod of iron, until his own death in 1916. For some years his colleague had been Dr. Edgar Willett, but he retired in 1905 and was replaced by my old friends, W. Foster Cross and H. E. G. Boyle.

It has seemed worth while to recall these facts as to the early history of anæsthesia at St. Bartholomew's in order to show how important a part Boyle took in bridging over the gap between the earlier anæsthetists, with their rough and ready methods, which he himself learned from Gill, and the more accurate and scientific proceedings of the present day. Although he could not justly claim, and certainly never did claim, any special scientific ability, it is to him, with his enthusiasm and driving power, as much as to anyone else, that we owe the extraordinary development in anæsthesia in the present century.

It will perhaps be convenient at this point to introduce the following biographical details before proceeding with the story of his later work.

Henry Edmund Gaskin Boyle was born in Barbados in 1875. He was educated there at Harrison College, from which he came to St. Bartholomew's. There he qualified M.R.C.S., L.R.C.P. in 1901. Except for a few brief visits he never returned to Barbados, but for the remainder of his life made his home in England. He finally retired in 1940 and was then appointed Consulting Anæsthetist to the Hospital. His health had been very poor for some time before this and he died at the age of 66 on October 15, 1941. In addition to the various war hospitals referred to below he was at various times on the staff of the Paddington Green Children's Hospital and the St. Andrew's Hospital at Dollis Hill. After qualification he was for a period Casualty Officer at the Bristol Royal Infirmary.

In 1901 he returned to St. Bartholomew's as Junior Resident Anæsthetist, with Foster Cross as his slightly senior colleague, and it is at about this time that we may date his decision to devote his future to anæsthetics. He told me once that this decision was taken largely on the advice of his almost lifelong friend and colleague, Douglas Harmer.

It may be interesting to recall, as far as memory permits, the methods of anæsthesia in use at St. Bartholomew's in these earlier years of the century—that is at the time when Cross and Boyle were Resident and, a little later, additional Visiting Members of the staff. These methods had developed but slightly from the drop-bottle-and-lint originated by Mills, but had been added to by a gas-and-ether induction, probably introduced by Gill and certainly practised and taught by him. When I was a student it was customary to induce anæsthesia with gas given in the large Cattlin's bag,

with a Clover Inhaler containing ether interposed between the bag and the facepiece. As unconsciousness supervened the ether was gradually turned on and the nitrous oxide discontinued. The Cattlin's bag was then replaced by a smaller one and adequate oxygenation obtained by periodic liftings of the facepiece to allow a full inspiration of air. In this way excellent ether anæsthesia was obtained and its depth controlled by the almost infinite variations in the strength of the vapour provided by the unrivalled simplicity of the Clover Inhaler. The breathing, however, tended to be somewhat heaving and the manipulations of the facepiece a little troublesome. Both these difficulties were avoided by changing over to open chloroform, by the Mills method, not more than half an hour after induction. In actual fact this was done not so much to improve the anæsthesia, but because it was universally believed that the administration of ether by this (or any other) method for more than about thirty minutes would most certainly cause serious pulmonary complications. Thus it came to be that all but the shorter operations were done mainly under chloroform anæsthesia. It is only fair to add that such was the skill of the administrators—Gill, Cross, Boyle, to name no others—that the method proved not only satisfactory but almost free from danger. Anæsthetic casualties were extremely rare. It would be difficult to say exactly when this method originated but it is certain that when I came to the Hospital as a student in 1901 it was *the* method, apparently always had been *the* method, and seemed extremely unlikely ever to be changed. In fact, anæsthesia was in a static condition, was tacitly assumed to have reached its zenith, and no further improvements were expected or even sought. Conditions remained much the same until shortly before the first war period. I well remember that when I joined the

Visiting Staff in 1916 my attempts to introduce open ether were somewhat frowned upon. The necessary simple masks and droppers were not to be found in the theatres and for a period I had to carry my own equipment from theatre to theatre. Any post-anæsthetic complications were ascribed to me and my dangerous method, even if investigation showed that the bronchitic patient had been anæsthetized by someone else with open chloroform. However, both during and before this time repeated efforts were being made to make more use of nitrous oxide and oxygen with or without small percentages of ether, especially in view of the advantages claimed in the case of war casualties in the field. There were various earlier appliances but for some time the most popular was Hewitt's rather clumsy double-bag apparatus. The difficulty was to keep the two bags at an equal pressure without which the percentages shown on the dial were meaningless. A clever later idea was to enclose one bag inside the other. There was, of course, no rebreathing and so the quantity of nitrous oxide used in a long operation was very considerable. Still, in spite of yet imperfect apparatus, definite advance was made. During the early war years Boyle himself was untiring in his efforts to promote gas-oxygen-ether anæsthesia. He felt ever more strongly that the old "rag-and-bottle" methods, good and useful as they had been, had already become outdated. About 1916 he persuaded the Hospital Authorities to import from the United States the first Gwathmey gas-oxygen-ether machine that had been seen in this country. I well remember his excitement when I helped him to unpack it in the Old Surgery at the Hospital. Several others were, I think, imported later.

It was no doubt for his strenuous advocacy of this new development, as well as in appreciation of his work as

Captain—R.A.M.C.(T) at the First London General Hospital at Camberwell, that Boyle was given the O.B.E. at the close of the war. He also did much other war work during these years at the Queen Alexandra's Hospital at Highgate, Lady Carnarvon's Hospital at Highclere, and Lady Evelyn Mason's Hospital.

It was soon found that in prolonged use the Gwathmey machines tended to develop certain purely mechanical defects, the chief being leakage at the gas unions. It was this that led Boyle to design his own machine. The early pattern was a somewhat clumsy and heavy wooden box with two metal crossbars from which hung the four cylinders. The "bubble-bottle" and the ether container were just above them. An early difficulty was caused by the tendency for the nitrous oxide, not then so pure or so dry as now, to freeze up at the valve. This had to be prevented by the addition of a small metal spirit lamp hung upon one of the bars so that its open flame could play upon the valve in use. This in spite of the fact that the ether container was but a few inches away! However, I am not aware that any serious accident ever resulted from such a dangerous arrangement, and it is certain that theatre anæsthetic explosions, which in recent years have become far too frequent, were in those days almost if not entirely unknown. Perhaps one explanation of the increased frequency of such disasters is the modern replacement of the now despised "bubble-bottle", which did at least moisten the gases, by the more scientific rotameters.

The original and admittedly clumsy Boyle machine was improved step by step and such modification still goes on. It would be impossible, at the present time, to estimate what percentage of anæsthetic machines in use in British hospitals are essentially Boyle's machines, and are known

by that name, but it must be a very high one. From none of these did the originator ever receive the slightest monetary benefit. In view of the sadly straitened circumstances of his closing years it may sometimes be wondered whether our high professional ethical standards do not perhaps err a little on the side of the angels.

The use of the new gas-oxygen-ether technique quickly spread at St. Bartholomew's, and, as might be expected, not without a certain amount of reactionary criticism, usually friendly, and sometimes even humorous. An early suggestion was that the excellent anæsthesia exhibited in the theatre with a minimal amount of ether, or none at all, was obtained by a more than liberal use of it during induction outside. It may perhaps be admitted that in the case of some junior and less skilled administrators this criticism sometimes contained a modicum of truth. One story had great popularity at the time. According to this, Boyle was himself giving the gas and oxygen with a minimum of ether (or none at all) while a surgeon was treating some piles with the actual cautery. So impregnated with ether was the blood said to be that it actually caught fire at the anus! The fact that marsh gas is also inflammable was of course not referred to.

As the gas and oxygen became generally adopted it was still at first usually reserved for the more general operations during which the anæsthetist could have fairly complete access to and control of the face. It was certainly one of Boyle's chief contributions to the method that he quickly appreciated this fault and devised means of overcoming it. This was done chiefly by the use of endotracheal methods, the more general adoption of which he had long urged. At the same time he was perfecting and promoting the use of gas and oxygen in midwifery.

Perhaps the most important event in Boyle's life, and one

which made his name a household word in anæsthetic circles on both sides of the Atlantic, was his visit to Canada and the United States in 1923 when he attended the Niagara Congress. He travelled extensively in both countries and made lasting friendships with leading American and Canadian anæsthetists such as Gwathmey, McKesson, Wesley Bourne, and of course that extraordinarily energetic and successful organizer of anæsthetists all over the world, the late Dr. McMechan. There is a story that when Dr. Wesley Bourne was "gonged" by the police for exceeding the speed limit in Montreal, he explained that he had with him "Dr. Boyle, the most distinguished anæsthetist in the world", and that they were late for a lecture. The policeman said "Proceed." Among the various ideas and appliances which he brought back with him was the Davis gag which, with some slight modifications, has been extensively used in this country ever since as the "Davis-Boyle Gag".

My own personal knowledge of "Cocky" Boyle dates from the time when he was resident anæsthetist and I a student and later House Physician at St. Bartholomew's. It was during this period that he was appointed to the Visiting Staff and we were perhaps a little amused at his quick assumption of an added dignity. It was then commonly said by the facetious (and may still be) that the real advantage of such a promotion was that the nurses were expected to address you as "Sir" and hand you a clean towel when you washed your hands. Boyle would have none of this, and in the most friendly and genial manner made the most of his well-deserved promotion.

It was not, however, until my return to the Hospital in 1916 that I came to know him really well. From that time until my own retirement (under the age limit) in 1935 I worked under and in very close association with him and

found him always a delightful and helpful chief. During the earlier part of this time and until his early retirement to Cornwall, W. Foster Cross was Senior Anæsthetist to the Hospital, but from then onwards Boyle held this position. It may be interesting to note that, although Boyle and myself were of the same age, under the curious regulations he, as having been appointed before 1912, did not come under the "60" rule and so had five more years to run than those appointed later. For all the years during which he was Senior Anæsthetist he was most active in directing and supervising the work of the Department and while avoiding any suspicion of friction strongly upheld the privileges and interests of his colleagues.

As a teacher he was an interesting and stimulating lecturer, but he himself relied far more on the practical instruction he gave to his clerks in the operating theatres. There must be many hundreds of his old students in many parts of the world who are grateful to him for helping them to maintain the old tradition that a "Barts" man could always be relied upon to give a decent anæsthetic. The simple principles which he taught were well set out in an excellent and popular little textbook which he wrote under the truly descriptive title of *Practical Anæsthetics*. It ran to three editions, with the last of which Dr. Langton Hewer was associated.

For many years a familiar sight about the Hospital and the West End was Boyle's small and somewhat antiquated "Saxon" car which looked scarcely roomy enough to contain his heavy and bulky apparatus and his somewhat heavy and bulky self. At long last, however, the gearbox dropped to pieces and an entirely new one was essential at a cost of £20. I well remember his disgust on being informed that the total value of the car *after* repair would be less than £5.

He had, therefore, to replace the old friend with a vehicle of more dignified appearance and more suitable size and power.

From the time of his first entry as a student Boyle was devoted to his Hospital and deeply interested in all its activities. Although working, in peace and war, at various other institutions they were but side issues. As a student he was President of the Abernethian Society and—a keen sportsman—was interested in all the athletic clubs. Until near the end he was always to be seen at all important matches. Perhaps the Cricket and Rugby Clubs were those to which he was most devoted. In younger days he was, I believe, a more than competent cricketer and captained the hospital side. He was fond of telling how, even later, he had made a century at the Oval. Only after adequate admiration, and possibly surprise, had been expressed would it slip out that it was in the course of a scratch match during the war, against the hospital porters. For some years he was President of the hospital Students' Union and was most active in supervising all its various activities. He was also a very keen Mason and at one time Master of the Rahere Lodge.

He always took a very great interest and active part in all movements towards the improvement of anæsthesia and the standing of anæsthetists. He was a member of the old Society of Anæsthetists and when this became merged into the Royal Society of Medicine as the Anæsthetic Section he was an active and, as has been truly said, not always a silent member. He occupied the presidential chair at its meetings in 1923. From its foundation he was on the Editorial Board of the *British Journal of Anæsthesia* and he was also an original member and a very strong supporter of the Association of Anæsthetists of Great Britain and Ireland. He

gave his assistance, too, to the somewhat prolonged negotiations which persuaded the Council of the Royal College of Surgeons to institute, with the Conjoint Board, the Diploma of Anæsthesia. He was one of the few who was granted this Diploma without examination (but not without fee!) and was also one of the first pair of examiners appointed.

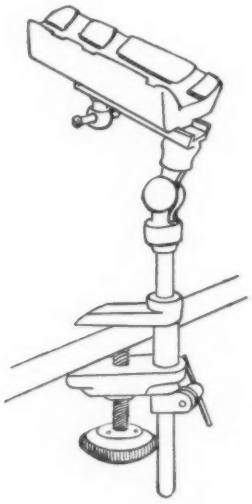
He had a great power of enjoying the good things of this life and making the best of the worst, but I doubt if anything ever gave him (and incidentally his friends) more real pleasure than when in 1935, the Council of the Royal College of Surgeons, under its special regulations, elected him to its Fellowship without examination.

He married, in 1910, Mildred Ethel, daughter of Mr. J. W. Wildy and widow of the late Mr. Leslie Greene, F.R.I.B.A. Mrs. Boyle was a partner in all his enthusiasms and a charming and gracious hostess at their house in Queen Anne Street. When his health began to fail it is needless to say that she looked after him with devoted care. Nor should a warm word of praise for his stepdaughter be omitted. She was entrusted with the care of his apparatus and, for more reasons than one, was careful to see that the cylinders in his machine were full and not empty ones.

I cannot but feel that in the above account of the friend and loyal colleague of so many years I have sadly failed to give a really adequate appreciation of his energetic, friendly, and generous character. His almost lifelong friend, Mr. Douglas Harmer, in a recent letter to which I am indebted for some of the details, sums him up in the following words: "He was a grand fellow, generous in the extreme, and one of the best of colleagues."

A HOLDER FOR WATERS' CANISTER

THE canister rests on a platform of "paxolite" which is, electrically, a non-conducting medium. The platform is mounted on a slide so that it is free to glide to and fro. The upper surface of the platform is "troughed" to accommo-



A holder for Waters' Canister

date the shape of the canister, and on either side of the platform are attachments to take the rubber strap which is looped over the canister to secure it in position.

The metal slide is linked to one end of a vertical rod by a strong insulated hinge-joint, which enables an upwards or downwards tilt to be imparted to the platform.

The other end of the vertical rod passes through a bearing in the clamp which rigidly fixes the whole apparatus to the edge of the operation table, forming a sliding joint by means of which the platform may be raised, lowered, or rotated from side to side.

The various joints are locked and freed by the manipulation of thumb screws.

Insulation of the platform is provided to remove any possibility of injury to the tracheal epithelium which might result from diathermy current tracking to earth via a wet endo-tracheal tube and unbroken metallic connections.

The apparatus was made for me by Messrs. Elliotts Ltd., Scientific Instrument Makers, Liverpool.

J. R. ESPLEN (Liverpool)

A USEFUL ANÆSTHETIC SCREEN

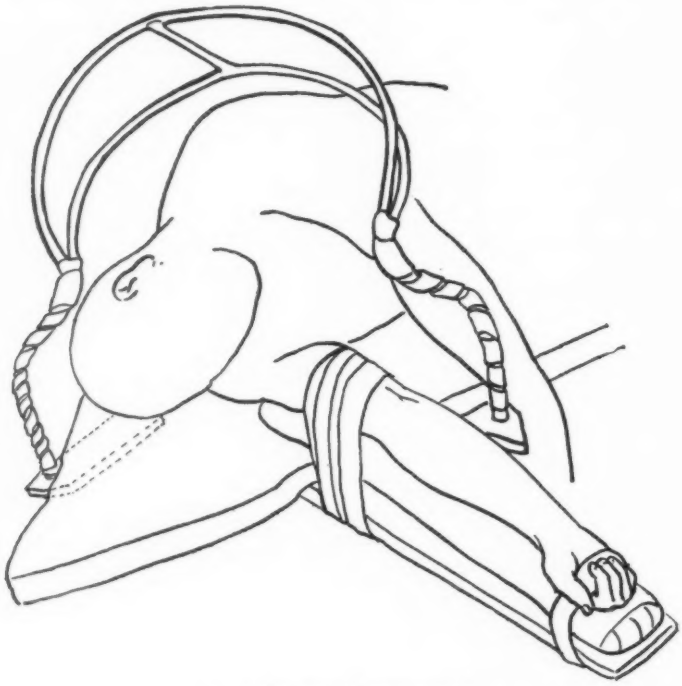
THE screen depicted was introduced for use during thoracotomy carried out with the patient in the lateral position and its shape enables it to be used for left- or right-sided operations.

The framework is made from high-tensile brass rod, which is covered by rubber sheathing wherever it is likely to come into contact with the patient. The brass feet are designed to slip between the top of the operation table and the sorbo cushion.

In use, the patient's upper arm, hanging down over the

table edge, lies outside the screen and his lower arm lies within the screen (see Figure).

The screen provides an unimpeded approach to any intravenous apparatus set up on the lower arm, gives good



A useful Anæsthetic Screen

access for bronchial aspiration, and enables the patient's face to be kept under observation.

The screen was made for me by Messrs. Elliots Ltd., Scientific Instrument Makers, Liverpool.

J. R. ESPLEN (Liverpool)

THE SHORT PERMANENTLY PATENT (P.P.) INTRAVENOUS NEEDLE

In the *British Journal of Anæsthesia* (July 1947) I described a needle for intravenous anæsthesia and therapy, the main feature of which was permanent patency. This needle is 2 inches long with a 45-degree bevel point, and made in gauges 17 to 23, fitted with a stilette.

In order to cope with difficult venupuncture, I have now modified this needle to $1\frac{1}{4}$ inches long and No. 23 gauge only. The long needle is still first choice for deeply set veins, and the short is particularly useful in:

1. Veins situated in curved part of the arm and back of the hand.
2. Superficially situated veins.
3. Small veins.
4. Tortuous veins.
5. Children's veins.
6. Veins around the ankle.
7. In an emergency veins in the neck or a man's bald head.

The method of insertion is as follows:

1. Fix the arm to an arm board.
2. Cleanse the skin over the selected vein with spirit and then wipe dry with a sterile swab (to enable the adhesive tape to remain adherent).
3. Lay a piece of sterile gauze over the arm distal to the site chosen for veni puncture.
4. Spray the skin over the selected vein with ethyl chloride in order to make a painless venupuncture.

5. Remove the stilette from the needle and insert it into the sterile gauze.
6. Make the vein prominent in the usual manner, and insert the needle with the bevel point facing upwards, when blood should then flow.
7. Place the stilette in the needle, making certain that the pin in its head fits into the notch in the needle hub.
8. Fix the needle to the arm with adhesive tape about 5 inches long and $\frac{3}{4}$ to 1 inch wide. The transparent cellulose adhesive tape is preferable to the elastoplast or ordinary adhesive tape, as it permits visibility and thus minimizes the risk of not noticing a dislodgement of the needle with consequent extravenous infection.

The needle is now ready for use at the convenience of the anæsthetist.

Continuous anæsthesia may now be given in fractional doses by simply removing the stilette, inserting the drug and replacing the stilette. The needle remains patent as long as it is in the vein, and is very useful for the thiopentone Tubarine sequence, and for post-operative intravenous therapy.

The needle is also useful for inserting through the wall of the rubber tubing of an intravenous drip. Thus one puncture of the tubing suffices for any number of intravenous injections and so avoids leakage which is apt to occur from numerous punctures with a non-stiletted needle.

These needles are made by Messrs. Chas F. Thackray, Park Street, Leeds.

EMILY E. JOHNSON (Wakefield)

COLLAPSE OF THE RIGHT LUNG FOLLOWING DENTAL EXTRACTIONS UNDER NITROUS OXIDE ANÆSTHESIA

DR. JOHN HALLAM (Liverpool) writes:

Mrs. A. B., aged 34, consulted her dental surgeon and was advised to submit to the extraction of 23 teeth. She agreed to this procedure but persuaded the dental surgeon, against his better judgment, to carry this out at one fell swoop.

Using nitrous oxide and oxygen, administered in a dental chair, all the teeth were duly removed. The haemorrhage was described as being rather excessive, and halfway through the operation the mouthpack was found to be sodden, and was renewed.

Some five days later, the patient reported back to the dental surgeon complaining of pain in the right side of the chest and dyspnœa; he referred her to her own doctor who was unable to find any physical signs. The dyspnœa and pain increased in the next twenty-four hours, and the patient went back to the dental surgeon who sent her up to hospital, where an X-ray revealed total collapse of the right lung.

A bronchoscopy was considered. The patient, however, on finding that another anæsthetic was imminent, was reluctant to co-operate.

Subsequently, X-rays taken at intervals over the next few weeks showed re-expansion of the lung to be taking place, this being complete in six weeks.

I have written elsewhere (Hallam, 1949) on "The importance of the control of blood during dental extractions", but feel that this case is so classic an example that it is worth recording.

REFERENCE

Hallam, J. (1949), *Brit. dent. J.*, **86**, 8, 205.

AUTHOR'S ABSTRACT

MASSIVE PULMONARY COLLAPSE FOLLOWING ANÆSTHESIA WITH CURARE

By R. FOREGGER, H. RETTIG *and* CONDE CONROY,
Milwaukee, Wisconsin,

[*Wisconsin Medical Journal*, 48: 1004–06, November 1949]

A 56-YEAR-OLD woman suffering from hypertension underwent an operation for the relief of partial intestinal obstruction due to adhesions. The induction and maintenance of anæsthesia were effected with cyclopropane using the endotracheal absorption technique. A moderate amount of ether was administered for 5 minutes following induction. After the operation commenced curare 3 c.c. (Introcostrin) was administered. Within a three-minute period the respirations ceased and artificial respiration was started. The operation consisted of lysis of intestinal adhesions and was finished in 1½ hours. The patient at this time had a good colour, the pulse was strong with a rate of 84 and the blood-pressure was 160/90. Artificial ventilation was carried out with oxygen for 8 hours. It was necessary to maintain vigorous artificial respiration with pure oxygen to prevent arterial anoxemia.

Some resistance to inflation of the lungs was experienced throughout the entire period of artificial ventilation but at one time it became extremely difficult to inflate the lungs. Bronchial râles were heard on auscultation, but no mucus could be aspirated from the trachea. Accordingly 1 c.c. of adrenalin was given intravenously. Immediately it became easier to inflate the lungs and the bronchial râles disappeared. But this effect was only transitory and soon again lung inflation required as much force as before the adrenalin.

At autopsy the patient had bilateral pulmonary collapse with no evidence of tracheobronchial obstruction. The history and physical findings did not offer any evidence of myasthenia gravis. No completely satisfactory explanation for the prolonged curarization and the massive pulmonary collapse could be made, but it was considered that in some manner they are most likely related to the administration of curare.

REVIEWS

Outline of Anæsthesia from the Nurse's Viewpoint. By C. Langton Hewer. pp. 24. No illustrations. Published by: Hospital and Social Service Journal. Price 1*s.* 6*d.*

This little book was of especial interest to the reviewer, as it has fallen to his lot to lecture to nurses on the subject of anæsthesia year by year for a quarter of a century.

As far as it goes it is, of course, as excellent as one would expect from Dr. Langton Hewer, but it is by no means sufficiently detailed. From the nurse's point of view the subject naturally divides itself into three parts, the preparation for anæsthesia, the giving of the anæsthetic, and the after-care of the patient who has received the anæsthetic. In this country the first and third parts are very important, and the second not so important as it should be. With regard to this second part, the reviewer has always held the opinion that a properly trained nurse with considerable practice was a much safer person to administer an anæsthetic than a newly qualified house surgeon with only twenty cases to his credit. If this policy had been adopted it would probably have saved many lives, reduced the amount spent on health services by many thousands of pounds, and saved specialist anæsthetists from much humdrum and tedious routine work. It would have left them fresher for the difficult and dangerous cases which make great demands on their time and skill. There is, of course, much to be said on the other side.

Now as regards the preparation of the patient for operation. Dr. Hewer has a heading, "Premedication and Care of the Unconscious Patient", but beyond stating a number

of routine procedures he gives no reasons for them, and to make the work interesting the nurse will require a great deal more of the why and the wherefore. How, otherwise, is she to take an intelligent interest in her work? When a patient is brought into the theatre to receive a spinal anæsthetic for, say, an abdominal section, the position of that patient on the table is of great importance, and the nurse should know what that position is and how to get it; but she would look in vain in this little book for advice on the subject. Again, it is no part of the nurse's duty "to sit at the head of the table and reassure the patient during operation" under spinal anæsthesia; that surely is the anæsthetist's job and one of the joys of the anæsthetist's life, for there is nothing that so stirs the gratitude of the patient as "a word in season" under such circumstances.

Excerpta Medica: Section ix, Surgery. Price: £6 4*s*. 0*d*. per annum.

We have been asked to draw the attention of our readers to the extracting periodical *Excerpta Medica*. This is published in fifteen sections covering the whole field of clinical and experimental medicine.

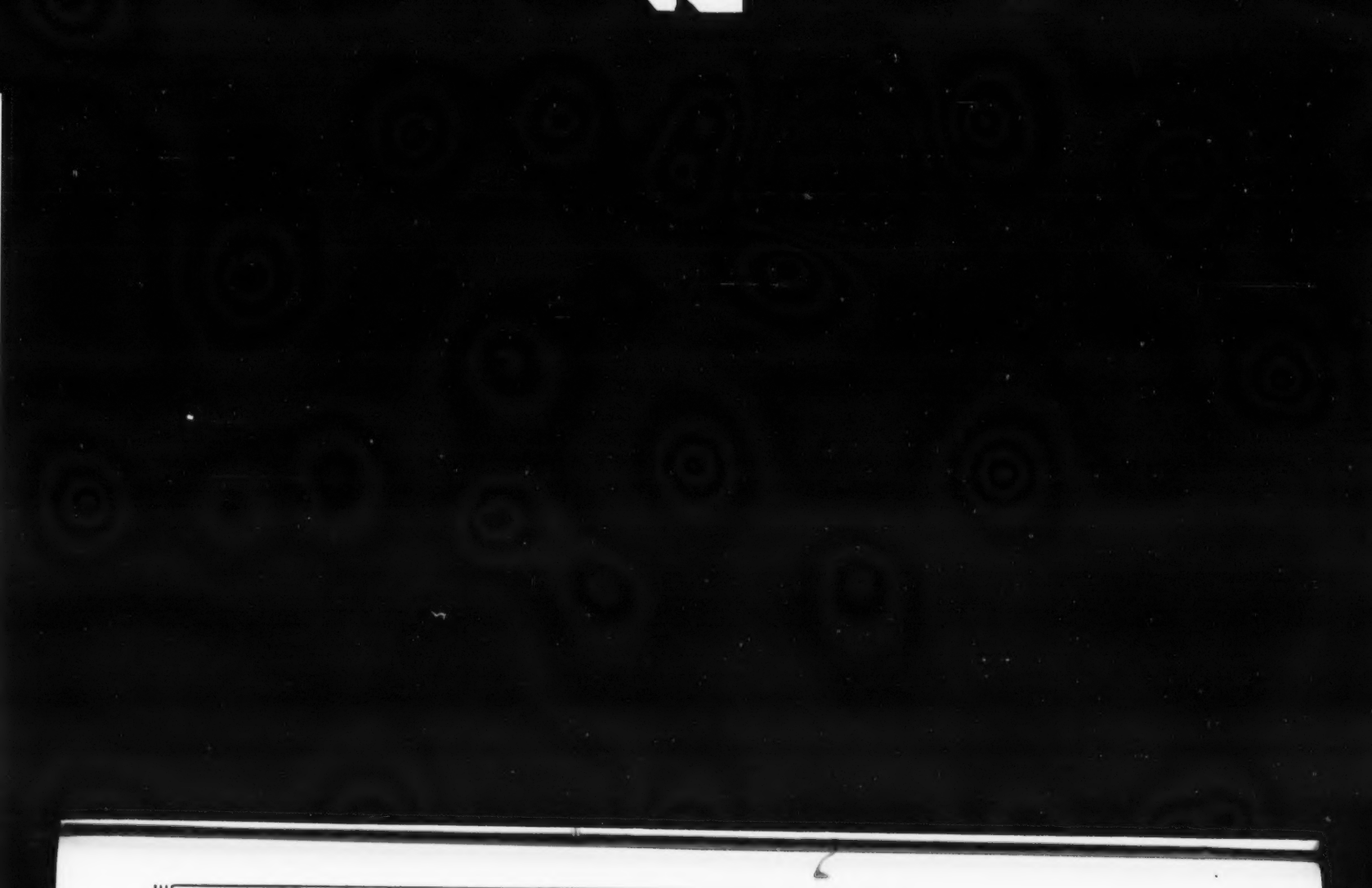
This monthly abstracting service of articles from all the available medical literature has been subsidized by the Government of the Netherlands since 1947 and hundreds of accredited abstracters throughout the world contribute. The General Editor is M. W. Woerdeman, who is the Professor of Anatomy and Embryology at the University of Amsterdam.

Abstracts of anæsthetic interest are included in the Surgical Section and this provides a most valuable reference service for workers in this field.

HOWARDS
STANDARD ETHER
for

ANÆSTHESIA

Manufactured by

HOWARDS OF ILFORD

Established 1797